

‘Cascade Bounty’ Red Raspberry

Patrick P. Moore^{1,2}

Washington State University, Puyallup Research and Extension Center, 7612 Pioneer Way E, Puyallup, WA 98371

Chad E. Finn

U.S. Department of Agriculture, Agricultural Research Service, Horticultural Crop Research Laboratory, Northwest Center for Small Fruit Research, Corvallis, OR 97330

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‘Cascade Bounty’ is a new floricane fruiting red raspberry (*Rubus idaeus* L.) jointly released by Washington State University (WSU), Oregon State University, University of Idaho, and the U.S. Department of Agriculture–Agriculture Research Service. ‘Cascade Bounty’ has been noted for high levels of root rot tolerance and high yields of mid- to late-season fruit on sites with severe root rot infestations. The fruit is tart, bright colored, medium size, and rounded in shape. The fruit of ‘Cascade Bounty’ machine harvests well, but the fruit does not appear to have sufficient cohesion to be suitable for individually quick frozen (IQF) processing. ‘Cascade Bounty’ is recommended for machine harvesting for processing uses. The name Cascade was selected to reflect the region where this cultivar was developed.

Origin

‘Cascade Bounty’ was selected from a cross of WSU 984 and ‘Chief’ (Fig. 1) made in 1992 at WSU Puyallup Research and Extension Center (WSU Puyallup). ‘Chief’ was released from the University of Minnesota in 1930 (Brooks and Olmo, 1972). ‘Chief’ is noted as being very winter hardy, and both parents of ‘Chief’ are ‘Latham’, which is known for being highly root rot tolerant (Jennings, 1988). WSU 984 was very productive at WSU Puyallup in the 1990 and 1991 harvest seasons. In previous trials at WSU Puyallup, ‘Chief’ was noted for having a rounded fruit shape, and WSU 984 was noted for having a very long, conic fruit. The seedlings from the crosses that year were planted in a field with high levels of root rot. As a seedling, ‘Cascade Bounty’ was very

vigorous and productive. It was selected in 1995 and evaluated as WSU 1162.

Performance

Fruit of ‘Cascade Bounty’ was harvested from replicated plantings at WSU Puyallup planted in 1996 and 2000. Plantings were arranged in randomized complete-block designs, with three three-plant replications, with 0.9 m between plants and 2.4 m between rows. Fruit was harvested one or two times a week, depending on environmental conditions and the weight of sound fruit and fruit with rot determined at each harvest. The average fruit weight for the season is a weighted mean based on the weight of a randomly selected 25 fruit subsample from each plot from each harvest and the yield for each harvest. Fruit firmness was measured as the force required to close the opening of the fruit using a Hunter Spring Mechanical Force Gauge (Series L; Ametek, Hatfield, Pa.), and was calculated as a weighted mean based on a randomly selected five-fruit subsample from each plot from each harvest.

Fruit samples of ‘Cascade Bounty’ were compared with ‘Cascade Delight’, ‘Meeker’, and ‘Willamette’ for pH, titratable acidity, soluble solids, and total anthocyanins. The pH of the juice was measured with a Corning 430 pH meter (Corning, N.Y.), titratable acidity by titration to pH 8.1 with 0.1 N NaOH, soluble solids with a Goldberg T/C refractometer (American Optical, Buffalo, N.Y.), and the total anthocyanins as described by Torre and Barritt (1977).

Harvest variables analyzed were total yield, percent fruit rot, individual fruit weight, midpoint of harvest, and length of harvest season. Only ‘Cascade Bounty’, ‘Cascade Dawn’, ‘Malahat’, ‘Meeker’, ‘Tulameen’, and ‘Willamette’ were in both plantings, and some cultivars died between the first and second fruiting season. Because of the different cultivars included in the plantings, and the differences in surviving cultivars from year to year, each planting and harvest season was analyzed separately. Data were analyzed as a randomized block design using General Linear Models (GLM) and Tukey’s “Studentized” range test Honest Significant Difference (HSD) for mean separation (SAS 8.1; SAS Institute, Cary, N.C.).

Other data were analyzed as a randomized block design using analysis of variance and Duncan’s multiple range test for mean separation (SAS 8.1).

Fruit production was measured in two Puyallup plantings that were hand harvested. Both the 1996 and 2000 plantings were on sites with high levels of root rot. On these sites, susceptible plants showed primocane wilting, floricane collapse, and blue/purple lesions at the base of the cane. For several cultivars, all plants in a plot died from root rot. Yield for these plots was set to 0 and other variables treated as missing values. In the planting established in 1996, ‘Cascade Bounty’ was compared with ‘Cascade Dawn’, ‘Comox’, ‘Encore’, ‘Malahat’, ‘Meeker’, ‘Tulameen’, and ‘Willamette’ (Table 1). ‘Cascade Bounty’ and ‘Cascade Dawn’ were similar in yield each year and had the highest yields. Because of root rot in the plots, there was considerable variability among plots, and in 1999 there were no significant differences among the surviving cultivars for all variables except midpoint of harvest. By 1999, all plots of ‘Encore’ and ‘Malahat’ had died. In the planting established in 2000, ‘Cascade Bounty’ was compared with ‘Cascade Dawn’, ‘Cascade Delight’, ‘Chilliwack’, ‘Cowichan’, ‘Malahat’, ‘Meeker’, ‘Qualicum’, ‘Saanich’, ‘Tulameen’, and ‘Willamette’ (Table 2). Before the 2003 harvests, all plots of ‘Cowichan’, ‘Malahat’, ‘Qualicum’, and ‘Tulameen’ had died from root rot, and all plots of ‘Saanich’ died before the 2004 season. In 2003 and 2004, ‘Cascade Bounty’ was extremely productive and had higher yields than all other cultivars. Fruit weight of ‘Cascade Bounty’ was similar to ‘Meeker’ in both harvest seasons, and both were smaller than ‘Cascade Delight’. Fruit firmness for ‘Cascade Bounty’ was similar to ‘Meeker’ in both years. The dates for midpoint of harvest were similar for ‘Cascade Bounty’, ‘Cascade Delight’, and ‘Meeker’. ‘Cascade Bounty’, ‘Cascade Dawn’, and ‘Cascade Delight’ were the only cultivars that had significant levels of root rot tolerance, especially as evidenced by the performance in 2004 (Table 2). ‘Cascade Delight’ was reported to have “some degree of field resistance to root rot” (Moore, 2004, p. 186). The results of these plantings indicate more tolerance than originally stated. The level of root rot tolerance previously reported for ‘Cascade Dawn’ was confirmed (Moore, 2006).

‘Cascade Bounty’ was subjectively evaluated in plots established in 2003 that were machine harvested at Burlington, Wash. ‘Cascade Bounty’ machine harvested acceptably for bulk frozen, puree, or juice uses, but the fruit does not appear to have sufficient cohesion to be suitable for IQF uses.

‘Cascade Bounty’ performed well in a planting established in 2000 at Oregon State University North Willamette Research and Extension Center, Aurora, Ore. ‘Cascade Bounty’ had high yields in 2002 and 2003, and the average yield (26.9 Mg·ha⁻¹) was

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¹Scientist.

²To whom reprint requests should be addressed; e-mail moorepp@mwu.edu.

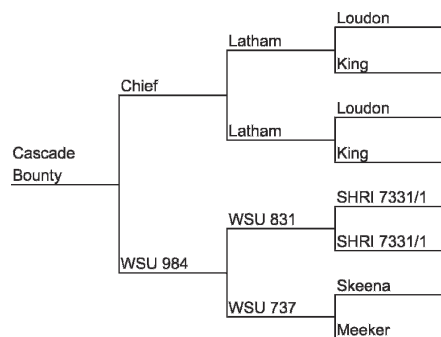


Fig. 1. Pedigree of 'Cascade Bounty' raspberry. SHRI 7331-1 is a selection from the Scottish Horticultural Research Institute.

not significantly different from the highest yielding cultivar 'Esquimalt' (14.9 Mg·ha⁻¹) or 'Meeker' (11.7 Mg·ha⁻¹). Fruit size was similar between 'Cascade Bounty' (3.4 g) and 'Meeker' (3.5 g; data not shown).

There was no significant winter damage for any raspberries in any of the plantings at WSU Puyallup when 'Cascade Bounty' was tested. Therefore, winter hardiness of 'Cascade Bounty' is unknown. However, one of its parents, 'Chief', is known as a good parent for winter hardiness (Jennings, 1988). Severe winter injury was seen in many 'Meeker' plantings near Burlington and Lynden, Wash., in 2006, but winter injury was not noted in 'Cascade Bounty' plantings in these areas.

Fruit Description

Fruit of 'Cascade Bounty' is tart with a good raspberry flavor. Fruit characteristics of 'Cascade Bounty' were compared with other Pacific Northwest raspberry cultivars (Table 3). The fruit of 'Cascade Bounty' had lower soluble solids and pH than 'Cascade Delight' and 'Meeker', but did not differ from 'Willamette'. The titratable acidity of 'Cascade Bounty' was higher than 'Meeker' and 'Willamette', but did not differ from 'Cascade Delight'. 'Cascade Bounty' had total anthocyanin concentrations similar to 'Meeker'. Because the fruit characteristics for 'Cascade Bounty' were similar to the processing cultivars 'Meeker' and 'Willamette', 'Cascade Bounty' should be acceptable for processing.

Fruit of 'Cascade Bounty' is generally round in shape and glossy (Fig. 2). Fruit morphological characters of red ripe fruit samples of 'Cascade Bounty' were compared with 'Cascade Delight', 'Meeker', 'Chief' (one of the parents of 'Cascade Bounty'), and 'Boyne' and 'Killarney' (both having 'Chief' as a parent; Table 4). 'Cascade Delight' fruit were much longer than they were wide and had a high length-to-width ratio (1.35). 'Cascade Bounty', 'Killarney', and 'Meeker' all had values near 1.0. 'Boyne' and 'Chief' had fruit that were somewhat wider than they were long and had values less than 1.0. 'Cascade Bounty' had large drupelet weights, with only 'Cascade Delight' having larger drupelets. The individual seed weight for

Table 1. Yield, fruit weight and firmness, and harvest season for 'Cascade Bounty' and seven other raspberry cultivars planted in 1996 at Puyallup, Wash., in a replicated trial and harvested in 1998 and 1999.^z

Harvest	Yield ^y (Mg·ha ⁻¹)	Fruit wt (g)	Fruit firmness (g)	Midpoint of harvest	Length of season (d)
1998 harvest					
Cascade Bounty	24.0 a ^x	3.70 ab	1.47 a	7/15 a	27 a
Cascade Dawn	24.9 a	4.25 a	1.58 a	7/3 e	26 ab
Comox	19.1 ab	3.59 ab	1.91 a	7/9 bc	23 ab
Encore	8.2 b	3.74 ab	1.85 a	7/10 bc	18 b
Malahat	20.5 ab	4.14 ab	1.68 a	7/8 c-e	26 ab
Meeker	17.5 ab	3.30 ab	1.62 a	7/14 ab	28 a
Tulameen	19.6 ab	4.17 a	1.56 a	7/11 a-c	23 ab
Willamette	16.1 ab	3.10 b	1.52 a	7/9 cd	25 ab
1999 harvest					
Cascade Bounty	17.7 a	3.10 a	1.57 a	7/19 a	28 a
Cascade Dawn	17.8 a	4.30 a	1.84 a	7/10 b	27 a
Comox	6.8 a	2.94 a	2.34 a	7/18 ab	21 a
Encore	0.0 a	—	—	—	—
Malahat	0.0 a	—	—	—	—
Meeker	9.8 a	3.34 a	1.69 a	7/22 a	22 a
Tulameen	2.9 a	3.64 a	1.62 a	7/17 ab	21 a
Willamette	4.9 a	2.70 a	1.79 a	7/9 b	22 a

^xBased on the means of three replications of three plants.

^yCultivars that died because of root rot had yield set to 0 and other variables treated as missing values.

^zMeans within a column followed by the same letter are not significantly different at $P \leq 0.05$, by Tukey's "Studentized" range test honestly significant differences (HSD).

Table 2. Yield, fruit weight, and firmness per harvest season for 'Cascade Bounty' and 10 other raspberry cultivars, planted in 2000 at Puyallup, Wash., in replicated trial and harvested in 2003 and 2004.^z

Harvest	Yield ^y (Mg·ha ⁻¹)	Fruit wt (g)	Fruit firmness (g)	Midpoint of harvest	Length of season (d)
2003 harvest					
Cascade Bounty	26.3 a ^x	3.3 b	1.60 ab	7/10 ab	25 a
Cascade Dawn	15.5 b	2.8 b	1.71 ab	6/28 d	22 a-d
Cascade Delight	19.5 ab	4.5 a	1.93 a	7/11 a	24 ab
Chilliwack	2.38 c	2.3 b	1.57 ab	7/3 c	19 b-e
Cowichan	0 c	—	—	—	—
Malahat	0 c	—	—	—	—
Meeker	2.6 c	3.2 b	1.71 ab	7/11 a	18 c-e
Qualicum	0 c	—	—	—	—
Saanich	3.59 c	2.4 b	1.40 b	7/8 b	22 a-c
Tulameen	0 c	—	—	—	—
Willamette	0.92 c	1.9 b	1.22 b	7/4 c	18 e
2004 harvest					
Cascade Bounty	34.0 a	3.5 ab	1.41 b	7/3 a	28 a
Cascade Dawn	14.0 bc	2.9 bc	1.68 ab	6/20 b	23 ab
Cascade Delight	19.5 b	4.2 a	2.18 a	7/1 a	22 b
Chilliwack	1.5 d	2.2 c	1.64 ab	6/23 b	20 b
Cowichan	0.0 d	—	—	—	—
Malahat	0.0 d	—	—	—	—
Meeker	5.2 cd	2.7 bc	1.70 ab	7/5 a	26 ab
Qualicum	0.0 c	—	—	—	—
Saanich	0.0 c	—	—	—	—
Tulameen	0.0 c	—	—	—	—
Willamette	0.0 c	—	—	—	—

^xBased on the means of three replications of three plants.

^yCultivars that died because of root rot had yield set to 0 and missing values for other variables.

^zMeans within a column followed by the same letter are not significantly different at $P \leq 0.05$, by Tukey's "Studentized" range test honestly significant differences (HSD).

'Cascade Bounty' was larger than the other cultivars.

Measurements were taken of fruiting laterals of 'Cascade Bounty', 'Cascade Delight', and 'Meeker' on 16 July 2004. The lengths of the fruiting laterals and the number of nodes per fruiting lateral were similar among cultivars. However, the number of fruit per fruiting lateral was much higher for 'Cascade Bounty' (29.0) than for 'Meeker' (20.0) or 'Cascade Delight' (15.0). The higher number of fruit per fruiting lateral for 'Cascade Bounty' was a result of more

fruit per node on fruiting laterals of 'Cascade Bounty' (3.2 fruit/fruiting node) than on 'Meeker' (2.3) or 'Cascade Delight' (1.5; data not shown).

Plant Description

The number of canes per hill was counted for three hills of 'Cascade Bounty', 'Cascade Delight', and 'Meeker'. 'Cascade Bounty' is very vigorous and, on a severe root rot site, produced more canes per hill (60.0) than either 'Cascade Delight' (39.7) or 'Meeker'

Table 3. Fruit analysis of red ripe fruit harvested from four red raspberry cultivars in July 2003 at Puyallup, Wash.^z

Clone	Soluble solids (° Brix)	pH	Titrateable acidity (% citric acid)	Anthocyanin ^y concn. (mg·g ⁻¹ fruit)
Cascade Bounty	10.6 c ^x	2.39 c	1.26 a	0.42 c
Cascade Delight	11.5 ab	2.75 a	1.33 a	0.63 a
Meeker	12.1 a	2.70 ab	0.85 b	0.46 c
Willamette	11.2 bc	2.52 bc	0.96 b	0.54 b

^zAnalysis of three replications of 10 g fruit.^yTotal anthocyanins determined spectrophotometrically from acidified ethanol extracts and expressed as cyanidin 3-galactoside (Torre and Barritt, 1977).^xMeans within a column followed by the same letter are not significantly different at $P \leq 0.05$, by Duncan's multiple range test.Table 4. Morphological characteristics for fruit harvested 18 and 25 June 2004 from six red raspberry cultivars grown in Puyallup, Wash.^z

	Cascade Bounty	Boyne	Cascade Delight	Chief	Killarney	Meeker
Fruit weight (g)	5.3 b ^y	2.9 c	7.1 a	1.6 f	3.7 d	4.5 c
Length (mm)	23.4 b	17.3 d	30.5 a	14.3 e	21.2 c	21.8 c
Width (mm)	22.0 a	19.2 b	22.6 a	15.6 c	21.2 a	21.9 a
Length-to-width ratio	1.07 b	0.91 c	1.35 a	0.92 c	1.00 b	1.00 b
Receptacle length (mm)	12.7 b	8.1 d	20.0 a	6.2 e	10.8 c	13.1 b
Receptacle diameter (mm)	8.3 b	6.7 c	9.9 a	5.0 d	8.5 b	9.5 a
Drupelet length (mm)	5.6 a	5.5 a	5.9 a	5.2 a	5.6 a	5.6 a
Drupelet width (mm)	4.0 bc	4.1 bc	4.7 a	3.9 bc	4.3 ab	3.7 c
Number of drupelets	85.8 b	60.6 cd	100.8 a	52.8 d	67.6 c	101.8 a
Drupelet weight (mg)	61.8 b	48.9 d	70.2 a	31.1 e	54.7 c	44.3 d
Total seed weight (mg)	187 a	97 b	192 a	74 c	113 b	199 a
Individual seed weight (mg)	2.18 a	1.60 c	1.91 b	1.40 d	1.67 c	1.95 b
Fruit color ^x						
L*	26.4 b	29.8 a	28.3 ab	27.9 ab	29.5 a	29.4 a
a*	19.9 b	27.6 a	29.4 a	25.1 a	24.7 a	25.5 a
b*	6.7 b	10.8 a	11.6 a	9.5 a	9.8 a	10.0 a

^zBased on five fruit per cultivar. 'Boyne', 'Chief', and 'Killarney' harvested on 18 June, and 'Cascade Delight', 'Meeker', and 'Cascade Bounty' harvested on 25 June.^yMeans within a row followed by the same letter are not significantly different at $P \leq 0.05$, by Duncan's multiple range test.^xColor measured as L*, a*, and b* with a Minolta Chroma Meter CR200b (Minolta, Ramsey, N.J.).Table 5. Morphological characteristics of the primocane leaves of six red raspberry cultivars measured at a 1.2-m height on 19 June 2003 in Puyallup, Wash.^z

	Cascade Bounty	Boyne	Cascade Delight	Chief	Killarney	Meeker
Petiole length (mm)	96.8 a ^y	65.1 b	85.7 a	58.0 b	57.4 b	94.3 a
Rachis length (mm)	49.5 ab	48.2 b	58.6 a	47.6 b	42.3 ab	53.6 ab
Stipule length (mm)	10.0 a	11.2 a	6.0 c	8.8 ab	7.1 bc	11.4 a
Color ^x						
Length (mm)	129.5 b	112.0 c	143.8 a	86.9 d	98.2 d	124.2 bc
Width (mm)	83.5 b	79.5 b	101.4 a	60.4 c	104.7 a	74.8
Petiolule length (mm)	16.6 bc	20.5 b	28.7 a	11.8 c	32.4 a	14.2 bc
Distal lateral leaflet						
Length (mm)	100.1 b	94.2 b	116.1 a	70.3 c	82.0	90.6 b
Width (mm)	53.7 b	55.6 b	64.7 a	41.8 c	56.5	43.1 C
Petiolule length (mm)	0.0 a	0.0 a	0.0 a	0.0 a	0.0	0.0 a
Basal lateral leaflet						
Length (mm)	124.9 a	108.4 b	135.4 a	85.3 c	84.1	109.2 bc
Width (mm)	78.1 b	73.6 bc	88.0 a	61.3 d	69.4	68.4 cd
Petiolule length (mm)	0.0 d	2.6 c	3.6 b	0.0 d	0.0 d	5.0 a
Color ^x , upper surface of leaflet						
L*	34.6 a	34.5 a	35.4 a	35.6 a	34.1 a	34.9 a
a*	-13.5 b	-12.1 ab	-13.5 b	-11.9 ab	-10.7 a	-12.7 ab
b*	15.9 a	14.6 a	16.7 a	16.5 a	13.3 a	15.5 A
Color ^x , lower surface of leaflet						
L*	51.5 c	53.1 bc	51.0 c	54.8 ab	56.3 a	51.1 cd
a*	-8.4 bc	-7.3 ab	-9.8 d	-7.3 ab	-6.4 c	-8.7 cd
b*	11.3 c	10.6 bc	14.2 a	11.9 b	9.3 c	12.4 ab

^zFive leaves were measured for each clone. All clones had five leaflets, except 'Killarney', which had one leaf with five leaflets and four leaves with three leaflets.^yMeans within a row followed by the same letter are not significantly different at $P \leq 0.05$, by Duncan's multiple range test.^xColor measured as L*, a*, and b* with a Minolta Chroma Meter CR200b (Minolta, Ramsey, N.J.).

Fig. 2. Fruit of 'Cascade Bounty' raspberry.

(19.0). Primocane length was similar for all three cultivars (data not shown).

At about 30 cm in height the canes had 20 to 40 spines/cm of cane. The spines are straight and point toward the base of the canes. There are pigmented spots at the base of the spine that are the same color or slightly lighter than the spines. The spine color is similar to 'Meeker' and lighter than 'Cascade Delight'. The midwinter color of the canes is similar to those of 'Cascade Delight', but canes of 'Cascade Bounty' commonly have high levels of waxy bloom on the canes. The waxy bloom makes the canes have more of a gray/purple cast. The canes are glabrous.

The leaflets of the primocane leaves are generally flat in cross-section. The petioles are pubescent and also have spines that are similar (but smaller) to those on the canes. The primocane leaves are pinnately compound with five leaflets, and the florican leaves have three leaflets. The leaves have two stipules. The distal lateral leaflets and the terminal leaflet of primocanes overlap slightly. The leaflets are doubly serrated and are generally ovate. The tips of all leaflets are acuminate to acute. The base of the terminal leaflet is rounded to cordate. The primocane leaves of 'Cascade Bounty' were compared with 'Cascade Delight', 'Meeker', 'Chief' (one of the parents of 'Cascade Bounty'), and 'Boyne' and 'Killarney' (both with 'Chief' as a parent; Table 5). 'Cascade Bounty' has larger leaflets than 'Chief' and 'Boyne', and larger terminal and basal leaflets than 'Killarney'. 'Cascade Bounty' is distinct from 'Cascade Delight' and 'Meeker' in having sessile basal leaflets with relatively symmetrical leaflet bases. The distal lateral leaflets of 'Cascade Bounty' are sessile with asymmetrical leaflet bases.

Disease and Pest Reaction

'Cascade Bounty' is susceptible to the large raspberry aphid (*Amphorophora agathonica* Hottes), the vector for the mosaic virus complex. Plants of 'Cascade Bounty'

have tested positive for Raspberry bushy dwarf virus using enzyme-linked immunosorbent assay. In unsprayed plots, the canes had a low incidence of spur blight (*Didymella applanata* [Niessl] Sacc.), less than 'Cascade Delight'. 'Cascade Bounty' has been planted in areas with high levels of root rot. A sample from a nearby raspberry selection showed severe root rot symptoms and tested positive for *Phytophthora fragariae* var *rubi* Wilcox & Duncan via polymerase chain reaction. On this site 'Cascade Bounty' has remained vigorous and has produced high yields.

Uses

The fruit of 'Cascade Bounty' is bright colored, tart, and glossy. Because of the fruit

acidity, size, and firmness, 'Cascade Bounty' is not well suited to fresh market use. 'Cascade Bounty' fruit machine harvested acceptably for bulk frozen, puree, or juice uses, but the fruit does not appear to have sufficient cohesion to be suitable for IQF uses. 'Cascade Bounty' is recommended for machine harvesting for processing use and is especially recommended for use on sites where other cultivars may have problems with root rot.

Availability

Names of propagators with certified 'Cascade Bounty' plants will be supplied on request. The Washington Agricultural Research Center does not have plants

for sale. Plant patent protection will be sought for 'Cascade Bounty'.

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